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"I think we need to get a better generator": Household resilience to disruption to power supply during storm events

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HIGHLIGHTS

- The resilience of UK householders to power cuts due to storms was explored.
- Resilience is achieved through modifying everyday electricity-related practices.
- DNO's should explore how to use community networks to communicate with households.

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ABSTRACT

Electricity is becoming ever more central to the everyday practices of households. As the energy system decarbonises, it is likely that electricity will supply even more services, thereby increasing the dependence of communities on reliable electricity supply. In this situation, the risk of power outages during extreme weather events poses a serious challenge to the safety and wellbeing of communities. However, little is known of the capacity of households to manage normal day-to-day life in such circumstances. This paper focuses on the UK winter storms that occurred in February 2014, the result of which 80,000 homes were left without power and communities not reconnected for several days. We outline the impacts these power outages had on households, describing the challenges faced and the strategies adopted to alleviate impacts. This provides insight into everyday household-level resilience achieved through social and material elements that constitute everyday life.

1. Introduction

The stormiest winter for two decades[1] saw a series of storms hit the UK between December 2013 and February 2014, causing coastal and inland flooding and high winds which damaged electricity networks, both directly and from flying debris. In December, more than 2 million customers lost electricity; 1 million lost power for more than 3 minutes and 16,000 were without electricity for 48 hours (Office for Gas and Electricity Market (Ofgem), 2014). In February 2014, 100,000 homes and businesses lost power following storms on the 12th of the month. Although UK weather is highly variable, the intensity and frequency of these storms was exceptional and storm tracks fell in lower latitudes causing severe gales in the South and West of the country.[2] Whilst such a period of extreme weather cannot be directly attributed to climate change, its impacts are recognised as presenting a risk to the future resilience of electricity infrastructure (McColl et al., 2012).

UK electricity networks are very reliable on a day to day basis; for example the reliability of the transmission network was 99.99987% in 2014/15 (National Grid, 2015) although, as the winters of 2013/2014 and January 2015 showed, they are vulnerable to the weather. Widespread disruptions have occurred as a consequence of wind storms in 1987, 1990, 1997, 2002, 2013, 2014 (Energy Networks Association (ENA), 2011) and 2015; wind also

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[1] http://www.metoffice.gov.uk/climate/uk/interesting/ 2014-janwind accessed 20th May 2014.

[2] The Recent Storms and Floods in the UK; February 2014; The Met Office.

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caused transient faults or the tripping of circuits during storms or due to blowing debris on a daily basis (National Grid, 2014). Whilst technical assessments often follow a power outage, there has been little research to understand the consequences of power cuts for those affected. This paper aims to fill this gap by exploring how householders who lost power during winter storms in February 2014 coped with the power outages. The paper briefly reviews existing research in this area, before moving on to consider the context of everyday electricity consumption. In Section 2, we present the methodology; the results in Section 3, followed by a discussion. The paper concludes by considering the significance of the results from an energy policy perspective.

1.1. Power outage research

Blackouts are prevalent across the globe, from China and the United States, to developing countries in Asia, Africa and South America, according to Byrd and Matthewman (2014) who conducted a review of power outage events reported in the media. Focusing more on a European context, research with households who have experienced power outages has been conducted in Finland (Silvast, 2008) and Sweden (Palm, 2009), where the outages were caused by storms, and in the Netherlands, where households were left without power for 3 days in winter due to a military accident affecting power lines (Helsloot and Bareens, 2009). These papers describe how most householders had alternative means of lighting and, to a lesser extent, cooking and heating in their homes; although this helped them to cope with the power outage, equipment was not kept specifically as a precaution against such events. For those living in rural areas, where every winter storm caused power outages, these were regarded as manageable and people had developed coping strategies (Silvast, 2008; Palm, 2009). Personal skills and mutual aid, for example providing food, were important, although Palm (2009) highlights the informal nature of this aid, suggesting that officials could make more use of such networks for communication and support. In particular, Palm (2009) identifies a communication mismatch, with electricity companies posting information on the Internet but local people seeking information via the media or phone. Knowing how long an outage may last, and enabling people to plan for the situation (Helsloot and Bareens, 2009), is particularly important. On a positive note Silvast (2008) highlights that many people enjoy the atmosphere of a power cut, particularly lighting candles, a finding echoed in other research (Devine-Wright and Devine-Wright, 2009; Yuill, 2004). For example, Yuill (2004) described the extensive black-out in New York in 2003, where his "reflective and reflexive" account and impressions were grouped into four distinct areas: a heightened sense of being, an absence of panic, a sense of 'keeping things ticking over' and the presence of mutual aid. Although he attempted to triangulate his personal experience of the power cut with data from other sources, his remains an individual account and hence it is not possible to tell the extent to which others shared his experiences.

In the UK context, Devine-Wright and Devine-Wright (2009) conducted discussion groups in contrasting locations of urban Leicester and a small Scottish community, where plans to upgrade power lines to a wind energy site meant that electricity was high on the local consciousness. The issues emerging from the discussions were further explored using a national online survey, which found weather to be the second most commonly identified cause of a blackout (15.4%), the most common being excess demand for electricity (18.5%); terrorism was third (15.2%). Power cuts were deemed to have both negative (bad for the image of the UK) and positive impacts (helping each other out and an absence of light pollution), depending on the length of the outage. Following power outages in London and Birmingham in 2003 that were due to technical faults, Brayley et al. (2005) conducted a survey to explore perceptions of blackouts. Although these prompted extensive media discussions at the time, the survey was conducted 18 months later and memories had faded. Research participants identified possible terrorist activity, a lack of investment, and past and present political decision-making as the potential causes of outages. When presented with blackout scenarios, interviewees were surprised at the possibility of such extensive blackouts and the scale of the resulting problems, and felt that swift reconnection of workplaces was prioritised over homes.

However our knowledge of how households manage their normal day-to-day life when faced with power outages remains limited, particularly in the UK. Understanding these coping mechanisms is important given the extent to which electrical services are pervasive and taken for granted, in some cases becoming invisible. The expectation is that this could leave residents ill prepared in the face of disruptions to power supplies caused by extreme events.

1.2. Electricity and everyday life

Electricity is becoming an ever more essential part of diverse everyday practices and economic activities; living and working without electricity is inconceivable to many. As the energy system is decarbonised, it is likely that electricity will supply more services, including heating and transport (Department of Energy and Climate Change (DECC), 2011), thereby increasing this dependence on a reliable supply of electricity. Electricity demand may rise in the future as an increase in cooling, as well as the electrification of services, places increased pressure on electricity networks.

In this context, power outages caused by network failures or extreme weather events pose a serious challenge to homes, businesses and communities, compromising their ability to function normally. Moreover, climate change impacts and increasing intermittent generation from renewable sources present challenges for maintaining the reliability of electricity services (National Grid, 2011). An increased likelihood of power cuts would result in an added level of vulnerability as societies become more reliant on electricity services, leading to wider disruptions and cascading effects and the failure of other services that rely on electricity (Graham, 2009). Thus, thinking about how society might respond to these challenges is crucial to ensure the safety and wellbeing of households and individuals.

A growing body of research has examined the resilience of power systems under a variety of challenges, for example in the context of disasters, such as the terror attacks of the 11th of September 2001 in New York (Mendonça and Wallace, 2006). Other studies have confirmed the impact of weather conditions on the daily operation of electricity service infrastructures (Yu et al., 2009), indicating the importance of being able to anticipate potential power system failures and identify effective mitigation strategies. Linnenluecke and Griffiths (2010) explored the impacts of extreme weather on businesses and industry sectors, highlighting the need for new approaches to understand and incorporate the impacts of climate change, including the increased impact of weather extremes, on businesses, organizational decision-making and corporate strategy. Also focusing on extreme events, Klinger et al. (2014) reviewed reported impacts on health from loss of electricity services during extreme events, revealing how integral electrical power and its supply are to essential services. This work, and other research mentioned earlier, demonstrate the extent to which the failure of the electricity network as a socio-technical system impacts on social systems which depend on it – homes, villages, towns etc.

1.3. Electricity, resilience and everyday practices

The resilience of a community is an important facet of ensuring its members' safety and wellbeing and how they cope with power cut disruptions. Conceptualising social resilience as an analogue of ecological resilience, Adger (2000: 361) defines social resilience as "the ability of communities to withstand shocks to their social infrastructure", in our case resulting from the disruption to electricity supply. Given the interdependencies between infrastructures, technologies, institutions, communities and households, resilience should be considered at different scales in order to understand how the actions at one scale influence those above and below (see for example Walker and Salt, 2012; Wilson, 2012; Chappells and Medd, 2012). The ability of households to respond to, and recover from, the loss of electricity depends not only on the household itself, but also on other actors and the social resilience of the wider community. The latter is intrinsic to a particular community; its material infrastructure and ability draw on different forms of capital (such as economic or social) and capabilities govern how it copes with challenges from serious incidents, extreme events or disasters (see for example Norris et al., 2008; Buckle, 2000; Wilson, 2012; Paton and Johnston, 2001). A further element to societal responses to events, drawn from the conceptualisation of resilience within the ecological resilience literature, is the importance of evolution and change thereby increasing resilience to future events (Folke et al., 2010).

The definition of what constitutes a community is always open to interpretation, but like Cutter et al. (2008), we understand a community as a "totality of social system interactions within a defined geographic space" (p. 599). This could be a neighbourhood, village or city, and in this research, community is both expressed and experienced through connections between people at the neighbourhood level. Variability in communities will result in differences in levels of vulnerability and the resilience of community members due to factors such as demographics, geographic location and the quality and type of the built environment. Whilst acknowledging that what constitutes a community can be ascribed beyond a territorial base, this paper follows a broad conceptualization of community as a loosely connected "social network of interacting individuals" (Johnson et al., 1994: 80), who – in this case – are living in areas that have experienced power cuts.

In understanding how resilience plays out at the household scale, we wish to move away from a behaviour-focused approach and look instead at how households "absorb disturbance and still maintain their basic function and structure" (Walker and Salt, 2006: 14). Consistent with socio-technical approaches (Guy, 2006), and permitting an understanding of everyday activities as situated within normalized practices, we find social practice theory to be useful in providing a framework for considering the functions of a householder and for theorising resilience for households and communities; in recent years the theory has been developed extensively in relation to consumption (Shove et al., 2012; Warde, 2005), particularly inconspicuous consumption such as energy (Guy and Shove, 2000; Shove, 2001) in buildings.

Firstly, practice theory emphasizes the intricate connections between material and social elements that constitute everyday life, performed on a regular basis such as cooking, keeping warm or entertainment. Each of these practices consists of material and technological elements as well as meanings, beliefs and values pertaining to them (Shove et al., 2012) and the know-how and skills (including knowledge, competence and technique) required for their performance (Reckwitz, 2005; Shove and Pantzar, 2005). With a practice theory perspective in mind, the power outage presents a situation where the linkages between the elements of the practice are broken, albeit temporarily. However, for normal everyday life to continue, existing practices need to be modified, new linkages need to be made incorporating new technologies and artefacts, and would require knowledge and competence for the practice to be performed in a power outage situation.

Furthermore, practice theory permits an understanding of how knowledge for new practices for resilience develops that is situated as situated in everyday life. From a sociological perspective, two types of knowledge are defined: embodied practical consciousness and discursive consciousness. The former is a type of hidden knowledge, which "enables individuals to 'go on' in daily life without having to make new decisions every moment," (Hobson, 2003: 104). This form of knowledge is experienced in the performance of normal everyday practices, whilst discursive consciousness, on the other hand, is informed by knowledge, experience and values. This presents the awareness with which individuals think and talk and is a cognitive form of knowledge (Hobson, 2003).

Secondly, understanding the everyday as a function of societal meanings, technologies and know-how allows for a meaningful analysis of the role of technological artefacts and buildings (Shove, 2004) in conducting our everyday life, highlighting how embedded appliances are entrenched in our typical activities. Finally, insights from practice theory have shown how practices circulate, transform and co-evolve. By exploring the everyday practices of households and how they are shaped by various elements including infrastructure, cultural meanings and economic functions, we attempt to build an understanding of resilience not only in the frameworks and procedures that constitute it but also by how it can be performed at the level of households and how resilience functions on a temporal scale, particularly as national and sub-national governments strive to incorporate resilience into planning future infrastructures and adaptation measures in the context of climate change (Hess, 2013).

Therefore, the resilience concept is at the forefront when thinking about how societies can achieve liveable and sustainable futures in the face of disruptions and possible disasters [UNISDR (United Nations International Strategy for Disaster Reduction), 2015], the challenge remains in understanding the impacts of such events on the vulnerability of large-scale infrastructures. This is made more complex in light of changes to infrastructures and new innovations in electricity services, such as smart grid technologies or smart metering, which undeniably affect communities and people in their homes. This paper focuses on the impacts of power outages on households during one extreme weather event. We outline the challenges that were faced, highlighting situations where the wellbeing of householders was at risk and delineate the strategies adopted to alleviate these impacts. The objective is to gain an insight into the everyday household-level resilience achieved by interrogating the social and material elements that make up people's everyday life and how these can be reassembled to achieve resilience in the face of power cuts caused by extreme weather.

2. Methods

A qualitative research strategy was used to explore how households coped in light of the power outages that resulted from storms during February 2014. The work consisted of 12 semi-structured interviews (Longhurst et al., 2010) with households in communities affected by power cuts[3], focusing on their experiences during the storm. The starting point for recruiting

[3] All material distributed during the recruitment and interview process was approved by the University of Manchester Committee for the Ethics of Research on Human Beings

households was to identify locations that had experienced significant power cuts, i.e. those that lasted more than 12 hours, as this would bring about marked changes to people's lives. From there, recruitment was narrowed down to specific postcodes. Following the storms in February 2014, where such power cuts affected large numbers of households, the island of Anglesey in North Wales and the town of Borth and Ynsylas in West Wales were identified as target areas based on reports in national and local media. Various strategies to identify and recruit individual households were deployed, including invitation letters posted through doors, personal contacts in large local employers and via a local community flood warden. The households contacted represented a varied demographic, given the small size of the communities in the two locations. Fieldwork proceeded until we reached saturation in the themes that emerged from the data.

In total, eight households were interviewed in Borth and Ynsylas and four on Anglesey in March 2014. Discussions focused on the single storm event of 12th February 2014 during which the entire population of Borth and Ynyslas, and some areas in North Wales, were without power for approximately 36 hours. The number of hours that households were disconnected varied slightly, with households being without power for between 12 hours to three days. Interviews lasted between 30 and 60 minutes and took place either in participants' homes, their place of work or at a B & B in Borth[4].

The qualitative approach adopted in this research provided the researchers with a rich account of the impacts of the weather event and the lived experience of power cuts from the interviews conducted, adding to a scarce literature on this subject (Helsloot and Bareens, 2009; Palm, 2009; Silvast, 2008). The interview topic guide explored how participants used electricity in their day-to-day lives but with a focus on how they were affected by and responded to the specific power cut event. The experiences of the interviewees were analysed in relation to practice theory understandings of 'what people do' (Shove et al., 2009) as well as the existing literature on living and coping with power cuts. Whilst unable to capture the richer details of daily electricity, the interviews employed for this research were deemed the most suitable, given the focus on an event of a limited timescale (the storm) and our priority to encourage interviewees to recall the events, their actions and feelings (during and after the storm) in relation to the power outage. This made the approach preferable to more immersive techniques such as ethnographic interviewing, which might better succeed at eliciting the richness of everyday practices, but could distract from the focus on the power outage incident.

3. Results

Several themes emerged in relation to how people coped with the power cut. These include households' perceived preparedness for weather events and their impacts, the efforts households made to keep warm, how they cooked or prepared food, and how they learned how to cope. Communication emerged as an important theme: with others in their neighbourhood, the electricity network operator and their friends and relatives.

3.1. Weather event preparedness

Preparedness in the event of a power outage depended on the extent to which homes relied on electricity for energy services such as cooking. heating and the appliances or heating systems installed. In some cases, fuel choice was informed by prior experience of power cuts, as for the following household:

> "We have in the past had power cuts and we have been conscious that when we changed the gas oven we were determined we weren't going to keep the oven and the hob the same power source … so we'd always have one thing or the other" (RP7).

Experience with previous power cuts was significant in enabling resilience and the maintenance of everyday life. One interviewee refers to her adaptability whilst also enlisting the necessary objects to help realize lighting and cooking services in her home, as well as the comfort of her household.

> "Because as I said over the years we've got used to it, you know. I had some candles in the drawer and we've got a gas cooker" (RP6).

During the weather event, many households were prompted to purchase emergency equipment, such as a camping stove for heating water and food, to help them cope during the long power cut.

> "I don't quite know why I felt [the power cut] was going to go on, but that just seemed a wise thing to do, to get something to heat some water up. I'd probably buy another camping stove, just so that you can boil water and do washing. You just have to deal" (RP8).

Acquiring these objects was important to enable cooking of meals, making hot drinks or heating water for washing. For some, it made families feel ready in the face of unusual weather. As one interviewee pointed out, after having purchased emergency cookers and heaters:

> "So that was sort of having us stocked for the future really, if it happened again. I felt quite safe then, I thought, right, it is sorted now" (RP2)

Some interviewees described being specifically prepared for events like these, such as this person who, living on her own, explains how she was equipped to manage a power cut:

> "I have a torch handy, actually. I have a head torch, which I keep in a fixed drawer so I know where to feel my way to it, and the candles and matches. I know exactly where they are. The other precaution is to always have a store of wood and coal in, [and] a spare phone. I've found that it was very awkward when we went to these new … cordless phones that need electricity supply. When we have a power cut, to have no phone was not good" (RP3).

Despite previous experience of power cuts, seeking alternative means of electricity supply was rarely discussed. In one house, an old generator left by previous owners was utilized. However, the power cut did bring the generator and its role into the fore, compelling this householder to make the generator more accessible. Alternative means of provision became more prominent in people's minds as they considered the possibility of more power cuts happening in the future. As this interviewee argues:

> "If we really are going to get more power cuts because of severe weather, because of climate change, I think we need to get a better generator and just use that. If we could get a decent one then we could just switch over to that and … we wouldn't have to worry" (RP6).

Another interviewee had needed email access and expressed a

[4] Participants received £20 high street shopping vouchers to thank them for their time. All interviews were digitally recorded, transcribed and analysed thematically using Atlas.ti software.

desire for alternative electricity provision:

> "[For the] relatively short term, [it] wasn't too bad but if it was going to happen longer term then you would want backup systems or ways you could deal with the things that you need to do such as keeping in contact with people, so whether you think about alternative places to go for the internet or whatever" (RP1).

For this resident, keeping in touch with others was not possible due to the loss of power and the need for an alternative source of electricity was again linked to the perception that extreme events might become more frequent in the future.

As mentioned earlier, practice theory invites us to consider the material contexts in which everyday life takes place. Thus the combination of objects and appliances available to households, described in the following sections, enabled the maintenance of vital everyday practices and therefore provided resilience during the power cut. The availability of camping stoves and heaters helped householders to achieve a degree of comfort and wellbeing for its duration. The same interviewee explains:

> "… people living opposite me were not as prepared - they had to go and buy heaters … and it cost them quite a lot of money-not that I particularly was prepared but it was just that over the years we had accumulated the right things" (RP7).

Similarly, a resident who rents her home and relies on under-floor heating, having purchased portable equipment for the storm, felt more confident about facing a similar event in the future. In this case, learning what was required made her feel more prepared:

> "I do not think I'd panic [in the future], but we've got candles, we've got the portable gas heater, we've got the little canisters that [my son] bought. I suppose we should stock up on those. You would think, well, we have got to cope" (RP9).

3.2. Keeping warm

In line with Harrison and Popke (2011), who present a relational account of living with fuel poverty, our analysis finds the contingency of coping with power outages in order to maintain warmth evident, as interviewees prioritised their immediate health and wellbeing needs. Technologies, experiences and ways of doing intertwined to help maintain wellbeing. With no mains gas connection to villages in west Wales, the households interviewed used a variety of heating methods, including log fires, wood burning stoves, range cookers, under-floor heating, liquefied petroleum gas (LPG) based central heating systems and storage heaters. However, all of the households relied on electricity in some way for their primary heating systems. The additional technologies had been chosen for a variety of reasons such as suitability for homes, efficiency, personal preference (such as being independent of certain fuel sources) and economy, given the high costs of LPG; they proved crucial in enabling homes to stay warm, becoming a primary source of heat during the storm when residents could not use their main heating system, as one resident explains:

> "I think it proved in February when the power went out for 27 hours, as soon as the property goes cold, we've got no means of warming it without an electric supply … even if it is oil central heating, it [needs] an electric supply" (RP10).

Changing routines and doing things differently was another way residents kept warm during the power cut, particularly those without alternative sources of heating. These included going to bed earlier than usual, heating water on camping stoves, using hot water bottles or covering up with blankets and wearing warmer clothes throughout the evenings:

> "We have got plenty of blankets and wrapped them round us … then we thought, well, we may as well go to bed and keep warm in there. So that's what we did" (RP9).

Furthermore, most households focused on warming one or two rooms in the house, either using log fires or wood-burning stoves, managing thermal comfort with limited heating options. As two interviewees explain below,

> "Well with the fire, it is fine down here and you just wear extra clothing" (RP8).
> "Obviously, there is only one warm room in the house, which is the sitting room, although we did put the oven on and leave the door open in the kitchen to keep it warm. So keeping warm was quite an issue" (RP6).

For the first interviewee, a combination of heating and extra clothing kept them warm through the first night, whilst the second interviewee was able to improvise using cooking appliances. Similarly, another resident explained how he kept his house warm, managing the temperatures in some rooms and adopting different strategies for their thermal comfort:

> "We would go into the lounge, which is where the stove was and that was already lit, so we would keep pretty warm more or less as normal. The bedrooms did get substantially colder and I'm pretty sure we had an extra duvet, but it was fine" (RP4).

Extreme weather events present particular challenges for those with medical needs, very young children and older people. The concerns raised from our study echo the views from Klinger et al. (2014) on the challenges healthcare services face in light of unusual or extreme weather conditions and the experience of heat waves in care homes for the elderly (Brown and Walker, 2008), whereas Middlemiss and Gillard (2015) provide a rich account of the lived experience of fuel poverty and the challenges householders face to keep themselves warm, including the quality of the build, ill health, tenancy and stability of income. In the research presented here, we identified several challenges which range from differing needs of people with chronic illnesses to more critical vulnerabilities for frail older people or those with disabilities. Below, one interviewee describes the measures she had to take to get through the power cut:

> "Because my husband has chronic obstructive pulmonary disease, he needs to be kept warm, and he feels the cold really badly. And I have got diabetes" (RP9).

Several of those interviewed reported checking on or inviting over elderly neighbours during the power cut days, including one interviewee who moved their mother to a relative's house that had electricity. Whilst the Distribution Network Operators (DNO) have a Priority Services Register, to ensure that the needs of older and vulnerable individuals are met during disconnections, participants' view was that such action could also be addressed at the community level, drawing on experience of community planning, such as that in place for flooding.

3.3. Cooking and meals

Households that were able to cook meals either used a wood burning stove, gas oven or camping equipment; a hot meal and hot drinks were very important to the people interviewed. As one interviewee explains:

> "Because we have a gas cooker… you just light it with a match and so were able to cook, which makes a big difference. And you can make yourself a cup of tea, which is good, which is the important thing" (RP6)

For those with electric cookers, camping stoves were one way of coping with the power cut. Whilst a few residents already owned them for outdoor activities, others had purchased them during the power outage. Some households supplemented the ones they already owned; one interviewee explained how she felt that her options were limited with only one camping stove, as she adds:

> "I would probably buy another camping stove, just so that you can boil up more water and do washing and things. You just have to deal with situations" (RP8).

In her case, to 'deal with the situation' the stove was used not just for cooking meals and making hot drinks but also to heat water to wash and maintain a degree of cleanliness. This convenience was essential to many, with a number of interviewees speaking of buying a camping stove to be used in extreme situations of this sort, as another explained:

> "[The camping stove] would probably be a useful thing just to have stuck in the cupboard just in case" (RP11).

In other cases, wood-burning stoves were used as improvised cooking stoves. The cooking of easy meals to make meal preparation more straightforward on the restricted cooking equipment, was mentioned by two of the interviewees:

> "So I got food that was quick to cook, and then we cooked quite a nice sort of camping meal on this little stove" (RP2).
> "I think the first night I actually went for the easy option – pasta and tomato sauce, but I made the sauce (we tend to do that rather than the bought ones) so it was easy but a little bit involved. The following night, for some reason we ended up buying food, but not easy food – gammon steaks. I remember thinking 'Why am I doing such a full blown meal when we could have had something simple?' – I don't know, but I think in hindsight we might have soup next time (laughs)" (RP1).

The second interviewee described not thinking of practical meals to cook with limited equipment, indicating the household was trying to carry on their daily lives as normally as possible, a concern also echoed by others. With hindsight, this interviewee would have preferred more practical meals, better suited to the appliances available or that could be easily prepared by candlelight. This points to a considerable readiness to adapt an assembly of artefacts such as food items and cooking appliances (suitable ingredients, camping stoves) for 'easy, 'practical' and 'quick' meals as opposed to 'involved', 'not easy' or complicated dishes.

Also related to food, concern extended to the risk of food perishing in the freezer if the power cut was to be a long one. For some of those interviewed, the freezer was used to store free-range or organically farmed meat, as well as large amounts of vegetables and fruits from gardens or allotments. Households had to dispose of it or, if they had the means, move it to friends' or relatives' homes. One householder reported using a diesel-based electricity generator to power the freezer alone. Referring to an earlier power cut, one interviewee recalls using the generator:

> "We did actually get it up and running for the outage that we had on Boxing Day. He got it running, and we plugged the freezer into it" (RP6).

However, during the February storm power cuts, this interviewee moved the food to a relative's freezer, who did not have power cut. For some, food preparation and preservation was particularly important, for example, feeding and caring for very young children presented a challenge to some households, and their needs were a priority for their carers.

> "We've also got a young great-grandson living with us, who was sixteen months at the time, you know, so he needed warm milk, he needed hot food, as we all did, but obviously we had to look after him" (RP9)

Sections 3.1 and 3.2 suggest that preparedness and feeling ready to face the storm and the associated power cuts are strongly linked with the adaptability to thermal comfort and cooking practices. From a practice theory approach (Shove et al., 2012), we consider the various elements that co-constitute everyday life and what people do for cooking and keeping warm. These everyday practices are linked to three elements: the materials that make keeping warm possible (e.g. heaters, insulation), the shared meanings of keeping warm and the ability to make sense of these elements to achieve warmth. Thus, people's ability to adapt to weather events has to be considered with reference to what they normally do and how they might do things differently. By understanding what people do as a combination of practices we can begin to link together the combination of appliances that households either had available or had to purchase. Another element of daily practices is know-how; the knowledge people had in order to cope with the power cut, such as that learned either from past experiences (growing up with frequent power cuts) or during more recent power disconnection events. Together, these elements made possible a household level resilience that was intricately linked to their everyday life, their houses and the objects and appliances they had in their homes. However, it is important to note that in the case of older household members and very small children, this resilience was challenged and the challenges to everyday practices were less easy to circumvent.

3.4. Community resilience: From household to neighbourhood resilience

An important factor in coping during the power cuts pertained to help between friends, neighbours and the local community. Neighbours checked in on each other, particularly if they were elderly. An interviewee recalled:

> "Our friend up the road, he came round to see if we were all right, and he says, you know, because we are both pensioners, he asked 'Are you all right?' and I said, 'yeah we're fine at the moment, a bit cold but extra layers and we will be alright.

This interviewee adds:

> "The fact that it is a community and it is a close-knit community. Everybody knows us, more or less, the paper shop, the shops, the butchers. You know there's help there if you want it" (RP9).

The notion that people belong to a 'community' with close links between members was felt strongly amongst participants. Neighbours looked out for each other and, in a small community, people trusted each other, knew where older or vulnerable people lived and visited to make sure they were well. In Anglesey, where homes were more dispersed than in Borth, interviewees nevertheless reported experiences of familiarity and friendliness from houses around them, pointing out that 'bringing people together' was a positive aspect of the power cut.

> "I think in any power cut, the good side of it is all your neighbours sort of go: 'you all right? Is your electricity off too? Can we do anything to help', and the same from us to them. The

community is quite rural and you don't often have that much interaction with your neighbours, although it is a very good community. But that's a positive, you get better communication with your neighbours when something like that is happening" (RP6).

In Borth, a local hospitality business provided support for some members of the community, including older residents who could not keep warm or could not prepare a meal without electricity. The business could not function during the power cut, but had a bottled gas supply, so although bookings were cancelled they were able to prepare hot meals and drinks. In a similar vein, local shops closed since being unable to use the cash registers, however the familiarity amongst residents had to positive impacts – with one shop serving local people informally. As one interviewee explains:

"I went to the shop and didn't know whether it would be open and of course, it's all darkness. I tried the door and thought they've obviously gone home. I was just walking away and one of the women from the shop came out and said, 'We're open. We're only letting people that we know in because we can't use the tills'" (RP11).

The feeling of community, whilst somehow intangible, is a theme that emerges strongly from the data, demonstrating the strong informal networks and high social capital within these communities. This points to the importance of looking beyond individual households when considering how resilience could be strengthened for those living in areas affected by extreme weather. In the cases included in this research, social resilience was intrinsic and informal, not bestowed from outside but provided by neighbours-people with access to essential services who could share them.

3.5. Knowing and learning how to cope with power cuts

To cope with and find solutions to the problems caused by the power cut, residents drew on past experiences from growing up in rural areas where having power cuts was part of normal everyday life. As one interviewee explained:

"Twenty or thirty years ago, when I was a young girl, the electric was off a lot and you got used to it and you expected it. Over the past fifteen years, you've gotten used to not losing your electric, and so you're not so ready" (RP6).

Similarly, some recalled their experiences and the knowledge they gained growing up in the UK during the 1970s, when miners' strikes and the consequent energy conservation strategies impacted on electricity provision.

"I remember them much more, you know, in childhood. I think in the seventies it was more common to have power cuts. I remember growing up with occasional power cuts, but actually in recent times, it has maybe been about twice or three times in the last seven years that I've lived in this house, so very rare really" (RP2).

Whilst interviewees stress the rarity of these events nowadays, their statements reveal how they had learnt to cope from their past experiences. This readiness was also expressed in making sure that they had items such as torches, gas bottles for camping stoves and similar objects that could help them feel prepared for future events. The same person goes on to explain:

"I must say, I did go to [the outdoors shop] and bought a couple of little gas bottles and another torch. So that way I was stocked for the future, really, if it happened again. I felt quite safe then, I felt 'Right, it is sorted now" (RP2).

In taking steps in preparation for future power cuts, those affected were clearly learning and adapting, thereby increasing the resilience of their households (Folke et al., 2010). With know-how and competence an important element from a practice theory lens, it is important to note that the learning the householders acquired in this case can only be performed and mobilised in connection with other elements that make their resilience possible: the objects they have at hand and the ability to adapt to varied meanings of comfort, and meal preparation, as elaborated in the earlier sections.

3.6. Communication: Being informed and connected

Research participants highlighted the importance of being able to use their phones, both landlines and mobiles. Those with a working landline had to use older plug-in handsets, as wireless phones did not work without electricity. Another challenge was keeping mobile phones charged – many charging their batteries at their workplace, but the prospect of losing battery power before the supply was restored loomed on people's minds. As one interviewee recalled:

"So my husband came home and we were going to swap over SIM cards, so I could use the battery on his phone, but luckily my friend had bought a [portable battery] charger, so it is a battery that you charge up and have an extra battery. So I used that to charge my phone up and make the called I needed. So having kept the old fashioned phone that you just plugged into the wall was a real bonus but later the telephone lines went down, it was actually just the mobile phone on low charge" (RP1).

A key reason for having a working phone was to remain informed about the power cut. Six of the twelve households that we interviewed had tried to contact the electricity network operator when the power cut occurred. Whilst some could not get through, several reported that there was only a pre-recorded message informing them of the scale and likely cause of the power cut and recommending that they call again if the power supply was not restored by a particular time. These messages had different impacts on the interviewees. One of those mentioned preferring to speak directly to another person, rather than listening to an automated message:

"This is the first power cut I've had where I've not been able to ring [the supplier] and actually talk to somebody. I missed not having that. I would prefer to have spoken to somebody directly and to say: 'my power had gone off'" [laughs] (RP3).

The preference to speak to another person was for reassurance that the power cut was acknowledged, and that the company was working to restore supply, but other practical implications include planning the home if householders knew when the power would be restored. One interviewee outlines the difference between the automated information and having the opportunity to speak to someone.

"The phone message that they leave you says 'If your electricity is not back on by', and it was like nine o'clock or midnight, 'then please listen again for another message', and so all the time you were expecting the electricity to come back on at any moment, because that's what they were saying. But if we'd got through to a person who might have said, 'oh, well actually, there's a big problem at the switching station, don't expect it on for two days', then we would have known" (RP6).

Knowing how long the power cut was likely to last was important in managing the expectations of residents in the

community and enabling them to plan, such as whether to buy camping equipment, move frozen food, or even leave the house for a few days. This was also relevant for vulnerable residents, for whom moving to relatives or friends houese would have been the best option. The experiences of residents with respect to communication with the DNO demonstrates the importance of unpacking the interactions between different scales when considering resilience (Walker and Salt, 2012). In this case, the lack of communication with the DNO reduced the ability of households to plan and hence affected their resilience.

4. Discussion

From the data presented, it is clear that households adopted different strategies to avoid compromising their health and wellbeing and maintain their safety and security as they coped with the power cut. Resilience is expressed in terms of coping for the duration of the event, of 'making do' or 'making the most of it'. Nevertheless, different responses from annoyance to discomfort, rising to some degree of panic, were also experienced. We find that the ways in which households managed during the storm related less to demographics, income or educational background. Rather, their actions depended on elements of their normal everyday practices. When thinking of what people do in their everyday life as constituted through different practices, we can begin to see how power cuts disrupt the flow and performance of a practice by rendering the material elements (such as appliances) unavailable. New elements have to be brought in, changing the practice itself and allowing householders to achieve their goals, whether it is in keeping warm or preparing the main meal. Although everyday practices such as cooking, heating and keeping clean were significantly disrupted, using makeshift cooking appliances and adapting by preparing simple meals, allowed participants in this study to meet their basic needs. In some cases, people had come face to face with their vulnerability because of their home, their neighbourhood or the needs of household members. This awareness was manifested sometimes in adaptive measures within the home – how to improve it, and what appliances and objects need to be acquired in order to be more resilience in the event of future power cuts.

Furthermore, the interaction with other members of the community proved an important factor in helping households to cope and retain a level of normality when modifying the elements of their everyday practices was not possible. In addition, measures external to the household, such as information from the electricity DNO and emergency services, also impact on the level of resilience that could be achieved in homes and communities. The experience of the events described makes salient society's increasing reliance on electricity (Byrd and Matthewman, 2014). Although many homes in the case study areas had alternative sources of fuel for heating and cooking, their need for communication services was significant. Mobile phones, cordless handsets for landlines and reliance on the Internet for information meant that the power cut left a recognizable hole; people found it difficult to connect outside their local community without electricity.

This study contributes to the understanding of resilience at the micro level of households, as an outcome of adapting and modifying everyday normal practices. We found that people prioritised heating and food over other practices, such as washing or laundry. How this was achieved differed between households depending on the characteristics of their house, the availability of services and appliances and family circumstances. Social practices and their implications on understanding energy use in the home has been the subject of increasing interest in recent years. Accordingly, thermal comfort was achieved by using a different combination of sources of heat; heating only a main room in the house and wearing warmer clothes. New meanings emerge in relation to food preparation, where people speak about 'easy' meals. Furthermore, the findings highlight the centrality of the main meal of the day and the level of household disruption if this is compromised.

Sections 3.1 and 3.2 demonstrate the importance of the material aspects of resilience and the socio-technical context of households that make it possible for practices to be achieved in different ways. Additionally, the insights from the interviews highlight how knowledge of how to manage during a power cut is gained, whether from recent local experiences or from growing up in the UK during the 1970s when power cuts were more commonplace. With reference to the two types of knowledge defined in theories of practice (Hobson, 2003), cognitive knowledge was acquired. When the usual practices are disrupted, households have to learn discursively and then apply that to their normal activities. For example, normally heating and lighting systems function in the background but when the power outage occurs, it makes these services visible – rooms need to be lit with different sources (lamps, battery operated lights, etc.) and people keep warm in limited or improvised ways. It is these discursive forms of knowledge, i.e. 'what to do when the electricity is out', that people have to draw on to be resilient to possible power cuts.

Therefore, from the practices standpoint, we suggest that understanding everyday resilience at the household level can benefit from thinking about resilience as performance, specifically performed through variations in the elements of existing everyday practices. This highlights several points. Resilience can be defined and understood as modifying the performance of practices through changing material elements, gaining knowledge for how 'to do' things during a power cut, and accepting new meanings for achieving comfort, convenience and cleanliness (Shove, 2003). This view also emphasises the material elements of resilience, including softer forms of technological interventions, as shown by the case of the camping stoves. When resilience is analysed as performance, it offers an understanding for how it can be mobilized under different conditions, allowing for a flexible strategy in addressing power cuts.

5. Conclusions and policy implications

Understanding resilience at the level of households and communities, as a process performed by people in their homes and neighbourhoods, is key to understanding how we can achieve greater resilience in the future. This is particularly useful when thinking about resilience to infrastructure loss or failure by bringing attention to normal everyday life and how it might be disrupted. In this paper, experiences during an extended power cut highlight how the wellbeing of households and communities can be compromised and how the vulnerability of certain members of a community might be aggravated. This study contributes insights on the impacts that power cuts during extreme weather events have on resilience, and the strategies to maintain or increase this resilience. By contributing a theoretical perspective from social practices, these insights can be useful when thinking of the impacts from power cuts on an international scale, considering local communities, their attributes and the practices prevalent in different geographical settings.

Typically, households find ways to manage during a power cut, prioritising certain aspects of their everyday lives. The results show that restoring some level of normality to homes for the duration of the power cut required material modifications, in many cases, technological elements of practices became central to the level of adaptability and resilience experienced by a household. Our research suggests that, after experiencing a significant

power cut, many households become better prepared to maintain their everyday practices should they experience another similar event in the future.

Households' different circumstances can have a strong influence on their resilience, especially those that include children, infirm, older or frail people or individuals with learning difficulties. Electricity provision has become ubiquitous across everyday services and loss of power can also mean disruption to services outside the home, for example shops without functioning tills. In these instances, inter-dependencies across households and communities are particularly pertinent as the communities provide refuge and support for vulnerable people, but these mutual support networks are also invaluable across the whole community. Thus responses to power cuts should not only concern individual households but could involve community-level intervention. Neighbourhood level assistance and information provision may be more appropriate than individual measures in some instances, enabling a focus on particular vulnerable households who might have difficulty leaving their homes. Coordinating how information and resources could be made available through the existing a priority services register could support such households and provide a move towards addressing resilience in the context of power cuts in a more holistic and effective manner.

Adequate provision of information, such as likely severity or duration of a power cut, is key to managing expectations and enabling households to maximise their resilience. Improved communication with service providers, whether DNOs or utility companies, may require identifying alternative ways to communicate. Recorded messages were perceived as being inadequate; more specific and systematically updated information would reassure households and enable them to plan what measures they might need to take. Furthermore, as modern landline handsets are not usable without power and mobiles cannot be recharged, community based strategies might be more effective.

Looking to the longer term, the consequences of significant power cut events in the UK remain highly uncertain since they are often the result of flooding or other extreme weather events. Not only are these events inherently unpredictable put unpacking the impacts of power cuts when communities might be faced with a host of other challenges becomes a complex process. However, as we see more of these events occurring, it is crucial that we can adapt and prepare for them.

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